

Serial No.: 09/553,374
Amendment dated: March 8, 2004
Reply to Office Action of: December 8, 2003
Atty. Docket No.: GJH-0019 (P1998J107A)

LISTING OF CLAIMS

- 1) (currently amended) A multi stage process for hydrodesulfurizing and hydrogenating a distillate feedstock having a sulfur content greater than about 3,000 wppm, which process comprises:
 - a) reacting said feedstream in a first hydrodesulfurization stage in the presence of a hydrogen-containing treat gas, said first hydrodesulfurization stage containing one or more reaction zones, each reaction zone operated at hydrodesulfurizing conditions and in the presence of a hydrodesulfurization catalyst, thereby resulting in a liquid product stream having a sulfur content less than about 3,000 wppm;
 - b) passing the liquid product stream to a first separation zone wherein a vapor phase product stream and a liquid phase product stream are produced;
 - c) passing the liquid phase product stream to a second hydrodesulfurization stage;
 - d) reacting said liquid phase product stream in said second hydrodesulfurization stage in the presence of a hydrogen-containing treat gas cascaded from, or partially cascaded from, the next downstream stage herein, wherein the rate of introduction of the hydrogen portion of the treat gas in this second stage is less than or equal to 1.5 times the chemical hydrogen consumption in this second reaction stage, said second hydrodesulfurization stage containing one or more reaction zones operated at hydrodesulfurization conditions wherein each reaction zone contains a bed of first hydrodesulfurization catalyst, thereby resulting in a liquid product stream having less than about 100 wppm sulfur;

Serial No.: 09/553,374
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Atty. Docket No.: GJH-0019 (P1998J107A)

- e) passing the liquid product stream from said second hydrodesulfurization stage to a second separation zone wherein a vapor phase stream and a liquid phase stream are produced;
 - f) collecting said vapor phase stream;
 - g) passing said liquid phase stream from step e) to an aromatics hydrogenation stage;
 - h) reacting said liquid phase stream in said aromatics hydrogenation stage in the presence of a hydrogen-containing treat gas, said hydrogenation stage containing one or more reaction zones operated at aromatics hydrogenation conditions wherein each reaction zone contains a bed of aromatics hydrogenation catalyst comprising a zeolitic support material, thereby resulting in a liquid product stream having substantially reduced levels of sulfur and aromatics, and a hydrogen-containing vapor product stream that is cascaded to an upstream hydrodesulfurization stage; and
 - i) combining the liquid product stream of step (h) with at least one of (i) one or more lubricity aid, (ii) one or more viscosity modifier, (iii) one or more antioxidant, (iv) one or more cetane improver, (v) one or more dispersant, (vi) one or more cold flow improver, (vii) one or more metals deactivator, (viii) one or more corrosion inhibitor, (ix) one or more detergent, and (x) one or more distillate or upgraded distillate.
2. (Original.) The process of claim 1 wherein step d) is performed so that the liquid product stream contains less than about 50 wppm sulfur.
3. (Original.) The process of claim 2 wherein step d) is performed so that the liquid product stream contains less than about 25 wppm sulfur.

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Atty. Docket No.: GJH-0019 (P1998J107A)

4. (Original.) The process of claim 1 wherein the catalyst of said first and second hydrodesulfurization stages are selected from catalysts comprised of at least one Group VI and at least one Group VIII metal on an inorganic refractory support.
5. (Original.) The process of claim 4 wherein the Group VI metal is selected from Mo and W and the Group VIII metal is selected from Ni and Co.
6. (Original.) The process of claim 1 wherein at least a portion of the vapor phase stream from said first separation stage is recycled to said first hydrodesulfurization stage.
7. (Original.) The process of claim 1 wherein at least a portion of the vapor phase stream from said second separation stage is recycled to said first hydrodesulfurization stage.
8. (Previously canceled.)
9. (Previously canceled.)
10. (Original.) The process of claim 1 wherein said second hydrodesulfurization stage contains two or more reaction zones operated at different temperatures, wherein at least one of said reaction zones is operated at least about 25°C lower in temperature than the other reaction zone or zones.
11. (Original.) The process of claim 10 wherein said second hydrodesulfurization stage contains two or more different reaction zones wherein at least one of said reaction zones is operated at least about 50°C lower in temperature than the other reaction zone or zones.

Serial No.: 09/553,374
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Atty. Docket No.: GJH-0019 (P1998J107A)

12. (Original.) The process of claim 10 wherein the last downstream reaction zone of said second hydrodesulfurization stage, with respect to the flow of feedstock, is the lower temperature zone.

13. (Original.) The process of claim 1 wherein said hydrogenation stage contains two or more reaction zones operated at different temperature wherein at least one of said reaction zones is operated at least about 25°C lower in temperature than the other reaction zone or zones.

14. (Original.) The process of claim 13 wherein said hydrogenation stage contains two or more different reaction zones wherein at least one of said reaction zones is operated at least about 50°C lower in temperature than the other reaction zone or zones.

15. (Original.) The process of claim 13 wherein the last downstream reaction zone with respect to the flow of feedstock is the lower temperature reaction zone.

16. (Original.) The process of claim 1 wherein the hydrogen-containing treat gas and said liquid phase stream of said aromatics hydrogenation stage flow countercurrent to each other.

17. (Original.) The process of claim 16 wherein said liquid phase stream of step e), prior to being passed to said aromatics hydrogenation stage, is passed to a stripping stage wherein it is contacted with countercurrent flowing hydrogen-containing treat gas in the substantial absence of catalyst.

18. (Original.) The process of claim 1 wherein the vapor phase stream from the second hydrodesulfurization reaction stage is cooled and the resulting condensed liquid stream is separated from the remaining uncondensed stream, and a portion of the condensed liquid stream is combined with the liquid feed to the aromatics hydrogenation stage.

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Atty. Docket No.: GJH-0019 (P1998J107A)

19. (Original.) The process of claim 1 wherein the aromatics hydrogenation catalyst is selected from those comprised of a noble metal on an inorganic refractory support.
20. (Original.) The process of claim 19 wherein the noble metal is selected from Pt and Pd.
21. (Currently canceled.)
22. (Currently canceled.)
23. (Original.) A distillate fuel product produced by the process of claim 1.
24. (Previously canceled.)
25. (Previously canceled.)
26. (Original.) The process of claim 1 wherein the treat gas provided to the aromatics hydrogenation stage is a once-through treat gas.